National Aeronautics and Space Administration

MARSHALL STAR

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FASTSAT satellite arrives at Alaska launch complex

Kodiak Launch Complex in Kodiak, Alaska

By Kim Newton

NASA's first microsatellite designed to create a capability that increases opportunities for secondary, scientific and technology payloads, or rideshares, to be flown at lower cost than before has arrived at Kodiak Island, Alaska, to begin final launch preparations.

The Fast, Affordable, Science and Technology Satellite, or FASTSAT, arrived at the Kodiak Launch Complex on Aug. 10 from the Marshall Space Flight Center. Following final checkout, the just-under-400-pound satellite will be integrated on a Minotaur IV launch vehicle as one of three secondary payloads.

"FASTSAT was selected as an 'outside-the-box' solution that afforded a highly synergistic concept which satisfied experiment, payload and launch

*See **FASTSAT** on page 4*

NASA lightning research happens in a flash

By Nick Brown

Lightning's connection to hurricane intensification has eluded researchers for decades, and for a riveting 40 days this summer, NASA lightning researchers at the Marshall Space Flight Center will peer inside storms in a way they never have before.

Earth scientists and engineers at Marshall will soon fly the Lightning Instrument Package, or LIP, a flight instrument designed to track and document lightning as hurricanes develop and intensify. In August and September, LIP will fly on a remotely piloted Global Hawk airplane over the Gulf of Mexico and Atlantic Ocean at an altitude of 60,000 feet. LIP will be part of a NASA hurricane study called Genesis and Rapid Intensification Processes, or GRIP for short. The study involves three storm chaser planes mounted with 15 instruments. LIP and the other instruments will work together to create the most complete view of hurricanes to date.

"We're now putting LIP on an aircraft that can stay in the air for 30 hours," said Richard Blakeslee, LIP principal investigator and Earth scientist at Marshall. "That's unprecedented. We typically fly on airplanes that fly over a storm for a period of 10-15 minutes. But this plane can stay with a storm for hours.

"We'll be able to see a storm in a way we've never seen it before," he added. "We'll see how the storm develops over the long term, and how lightning varies with all the other things going on inside a hurricane. It's the difference between a

*See **Hurricane** on page 5*

The chemistry of rocketry – more than rocket science

By Thomas Shattuck

Rocket science is not just rocket science. There is plenty of chemistry involved in getting a launch vehicle off the ground and putting satellites into orbit and beyond.

"Using chemical propulsion, rockets have expanded mankind's reach into the universe and made possible the exploration of space," said David Ricks of the Spacecraft and Vehicle Systems Department in Marshall Space Flight Center's Safety and Mission Assurance Directorate. "Scientists, including chemists, in past years have explored the natural world around us. Scientists and engineers have learned to harness the secrets of chemistry to provide propulsion and help us explore space and improve the human condition."

While the mechanics of spaceflight can be awe inspiring, the traditional rocket motor is essentially inert without the chemistry to power the propulsive systems.

For example, most people are familiar with the massive J-2 engines that lifted the Saturn V's second and third stages, but the chemistry behind the liquid oxygen-hydrogen oxidizer-fuel is usually overlooked.

This mix of cryogenic fuel and oxidizer has been used with not only the Saturn V, but also in the Space Shuttle Transportation System, Atlas V and the Delta IV. These systems provide control, allowing the user to throttle, shut down and even restart the engines. Equally important, the liquid oxygen-hydrogen systems provide greater specific impulse than their solid counterparts do. This impulse is similar to mileage in a car: The rocket can travel farther with less fuel.

The current Space Shuttle Transportation System has the advantages of both liquid and solid engines. "The shuttle gets the benefit of the thrust from the boosters and the benefit of impulse from the space shuttle main engines," said David Reynolds of the Propulsion Systems Department at Marshall. "The large thrust from the boosters helps launch the shuttle off the ground and fight gravity until the orbiter can reach a higher altitude where air drag and gravitational forces play a less significant role. At this point, the high impulse provided by the engines helps the orbiter reach orbit and perhaps dock with International Space Station."

"Once basic human needs are met, it is dreams and aspirations that motivate humanity. To me, NASA has been about progress, and exploration driven by mankind's insatiable curiosity about the universe."

— David Ricks, Spacecraft and Vehicle Systems Department

In the future, other liquid systems will be used. While liquid oxygen has proven to be a suitable oxidizer, liquid hydrogen fuels pose significant challenges for long-duration spaceflight. Liquid hydrogen would require an active refrigeration system to maintain the fuel tanks at a frigid minus 422 degrees Fahrenheit. Methane on the other hand could prove easier to work with.

"The propellant combination of liquid oxygen and liquid methane are considered "soft cryogens," which generally means with some effort they could be stored for relatively long periods of time in space using passive, multilayer insulation-wrapped tanks," said Jack Chapman of the Spacecraft and Auxiliary Propulsion Branch.

"Unfortunately, the specific impulse

An Ares I Upper Stage Subscale Motor Test at Marshall

*See **Rockets** on page 3*

Huntsville Times editor to speak at Marshall Association on Aug. 18

The Marshall Association will host a luncheon at the Redstone Officers' and Civilians' Club in Building 130 on Golf Course Road on Aug. 18. Kevin Wendt, editor of The Huntsville Times, will speak about balancing the need for innovation and creativity in journalism to survive amidst an explosion of media types with the need to maintain the integrity of your operation.

Wendt was named editor of The Times in 2008. He previously spent eight years at the San Jose, Calif., Mercury News where he most recently was an assistant managing editor.

During the luncheon, winners of the 2010 Marshall Association Scholarships will be announced. The scholarships are awarded each year to dependents of qualifying members of the association.

The meeting will begin at 11 a.m. Lunch will be $13 for Marshall Association members and $15 for nonmembers. Those planning to attend should contact Larry Gagliano at larry.gagliano@nasa.gov or Angie Williams at angie.williams-1@nasa.gov by Aug. 14. Any cancellations after that date or no-shows will be expected to pay.


Kevin Wendt

For those interested in joining the association, a $25 membership fee can be paid at the door. Membership is open to the entire Marshall community.

For more information about the association, visit http://inside.msfc.nasa.gov/marshall_association/.

Rockets *Continued from page 2*

for liquid oxygen/liquid methane is somewhat lower when compared to liquid oxygen/liquid hydrogen, increasing the overall weight of the fuel needed for space travel," said Chapman. "Liquid methane does have a higher density, which means the volume needed to contain the fuel would be less, which would reduce the weight of the vehicle not considering the fuel. The benefits and disadvantages of this weight are still undefined.

"Whether or not the lower spacecraft dry mass for a liquid oxygen-liquid methane propulsion system offsets the increase propellant mass needs to be assessed, or traded, on a case-by-case basis."

Getting there, however, is more than just burning fuel. Chemical propellants can be difficult to store, both on ground and in space, and destruction of their containers also poses problems. Corrosion can clog small flow passages or cause an unexpected drop in pressure. Pressurized gases dissolved in solutions can change, causing unstable combustion. All of these problems could cause mission failure depending on the severity or location of the interruption.

While liquid- and solid-fuel-based propulsion systems have provided much of the power behind past rocketry, other developments, both new and old, have to be used for certain specific applications. Some of these systems derive energy from unusual sources including nuclear reactors and solar paneling. This energy can be converted into thrust by accelerating ions or heating non-combustive propellants. Of course, there is also the option of "sailing" by catching solar wind in a sail, thus propelling the craft.

These non-combustion systems lack the thrust needed to launch off the planet, but have high specific impulses that are needed for practical, long-duration spaceflight. At Marshall, the focus includes using heat from nuclear fission, fusion or the sun to heat a fluid, using the thermal expansion to provide thrust.

No matter where the future of space exploration leads, chemistry and its derivatives will be needed to provide the power to tour the cosmos. And while traditional chemical combustion engines will be needed, new technologies and new methodologies will be combined to maximize the distance both manned and unmanned spacecraft will be able to travel.

Shattuck, a chemical engineering student from Vanderbilt University, was a summer intern working in the Public and Employee Communications Office.

FASTSAT *Continued from page 1*

schedule requirements," said Mark Boudreaux, FASTSAT project manager at the Marshall Center. "This milestone brings us one step closer to developing a unique, small satellite platform and the environment needed to perform low-cost research in space."

Outfitted with six technology and atmospheric experiments, the microsatellite will lift off from the Kodiak complex no earlier than Sept. 24. The satellite will be launched into a 404-mile circular orbit to perform the 180-day mission.

The overall objective of the FASTSAT mission is to demonstrate the capability to build, design and test a microsatellite platform to enable governmental, academic and industry researchers to conduct low-cost scientific and technology experiments on an autonomous satellite in space.

Mission operations for FASTSAT and all six experiments will be managed from the small satellite control room at the Huntsville Operations and Science Control Center at the Marshall Center.

FASTSAT will fly on the STP-S26 mission – a joint activity between NASA and the U.S. Department of Defense Space Test Program. The satellite was designed, developed and tested at the Marshall Center in partnership with the Von Braun Center for Science & Innovation and Dynetics Inc. of Huntsville. Dynetics provided key engineering, manufacturing and ground operations support for the new microsatellite. Thirteen local firms, as well as the University of Alabama in Huntsville, were also part of the project team.

For more information about NASA small satellite missions visit www.nasa.gov/mission_pages/smallsats/.

Newton is a public affairs officer in the Office of Strategic Analysis & Communications.

Classified Ads

To submit a classified ad to the Marshall Star, go to Inside Marshall, to "Employee Resources," and click on "Marshall Star Ad Form." Ads are limited to 15 words, including contact numbers. No sales pitches. Deadline for the next issue, Aug. 19, is 4:30 p.m. Thursday, Aug. 12.

Miscellaneous

Two Petmate plastic carriers 18 x 18 x 26, wire door 256-881-0457

Red two seater Croozer 535 bike trailer, $100; infant changing table, wooden, $50. 256-551-0467

Engagement ring, 1.33 carat, white gold, center stone, baguettes down sides, $1,500. 256-701-5304.

Computer desk, $20; book case, $20, photos available. 256-653-4835.

Small executive desk, solid wood, heavy duty, 29 x 48 x 30 $150. 256-882-0461

Yamaha "Advantage" Alto-Saxaphone. 256-738-8048

Drexel king headboard, $100; Amores mahogany, $300, pine, $150; glass/brass coffee table, $150. 256-603-5279

Big Bertha towable tube, full size for three people. $50. 256-975-9325

White wire shelf for closets, five total, five feet each, $25. 256-651-5847

Steel front bumper for John Deere 100 series riding mowers, $25. 256-880-6544

Playstation 3 game, Little BIG Planet, Game of the Year edition, rated E, $25. 256-828-1234

Weslo aero exercise bike, $30; angle iron, $1 each; camper shell, $25. 256-852-6952

Vehicles

2007 Hyundai Santa Fe Limited, white, leather, sunroof, new tires, 55k miles, $16,900. 256-651-2257

2003 Keystone travel trailer, 32ft, slide, queen bed, microwave. 985-710-2850

1998 GMC LWB truck, 6 cylinder, white, 178k miles, $4,500. 256-468-9377

1998 Stingray RS180 Bowrider, seats seven, bimini covers, fish/ski, new 140 I/O, $9,500. 256-640-6427

1994 Nissan Sentra, 160,000 miles, $1100 obo

Wanted

Students interested in obtaining beginner to advanced scuba diver certification. 256-651-9909

Used Verizon Samsung Intensity phone or Verizon LG Cosmos phone with home charger 256-508-0509.

Iphone 3g or 3gs. 256-527-8116

Microscope for high school use. 256-464-3639

Shuttle Buddies to meet Aug. 23

The Shuttle Buddies will meet at 8:30 a.m. Aug. 23 at Mullins Restaurant on Andrew Jackson Way. For more information, call Deemer Self at 881-7757.

single photograph and a full-length movie. That's quite a paradigm shift."

While scientists know an increase in lightning means the storm is changing, it remains a mystery as to whether that increase signifies strengthening or weakening. Though scientists have quite a few ideas, they lack the data to firmly establish a concrete relationship.

Researchers hope LIP's upcoming flights will change that. If scientists can figure out the ties between lightning and hurricane severity, meteorologists may be able to greatly improve their short-term forecasts. Researchers have connected lightning to everything from strong winds to flooding to tornadoes, and a few extra minutes of warning time can save lives each year.

The instrument will measure the amount of lightning produced by hurricanes and tropical storms.

"We can use lightning as a natural sensing tool to see into the heart of a storm," said Blakeslee. "Lightning allows us to get at rain and other processes going on within a storm."

For Blakeslee and the rest of the LIP team, the hurricane study this fall presents a tremendous opportunity. In its nearly 15-year lifespan, LIP has flown nearly 100 missions in 10 major field campaigns, soaring over more than 800 storms. That's unparalleled for a lightning instrument, according to Blakeslee, and LIP researchers hope it will continue its long tradition of successful research.

The guts of the Lightning Instrument Package

LIP's instruments may look simple, but they're surprisingly complex. To measure the electric field in a storm, the instrument relies on electric field mills, devices that allow scientists to measure the amount of lightning a storm produces. Originally developed at NASA, the mills look like big cans – each about a foot long and approximately 8 inches across. As the instrument flies through the air, a plate covering each can rotates, covering and uncovering four metal disks housed inside. Uncover a disk and electricity from the storm rushes in. Cover the disk and it rushes back out. The whole process converts the electrical current from DC to AC and back to DC, allowing scientists to measure how strong a storm's electric field is, and how prone to lightning it might be. A sudden shift in the strength of the electrical field allows scientists to determine that a lightning strike has occurred.

In addition, a conductivity probe reveals how easily electrical current can flow through the storm to the upper part of the atmosphere. The probe is a small nose-cone-shaped device with two sensor tubes attached to each side. As the plane flies near a hurricane, small electrical particles called ions rush through the tube, allowing the team to count them.

The LIP team uses all that data to determine how much lightning a hurricane produces and where it originates within the storm. By combining that data with wind speed, rainfall rate and other information, researchers can connect how lightning relates to hurricane intensification. And because Blakeslee and his team get their data real time, they can redirect the plane as needed to improve the likelihood of quality results.

After the summer hurricane study ends in September, the team will analyze, evaluate and eventually release the data – a process which should take several months. Following that, the Lightning Instrument Package will continue to fly in hurricane and storm studies in hopes of collecting more data. The more data, the better the forecasts, Blakeslee said – and the nearer scientists move to understanding these powerful storms.

Brown, a communication of science and technology student from Vanderbilt University, was a summer intern working in the Public and Employee Communications Office.

Center Management Council visits East test area for lander test

Marshall Space Flight Center's Center Management Council, or CMC, usually holds its monthly meetings in a conference room setting, but not this time. The group made a trip to the East test area to see a robotic lander take flight and perform a controlled landing.

The Robotic Lunar Lander Development Project has been performing these tests since August 2009, and has conducted over 125 flights as part of a risk-reduction activity that will bring the project closer to building a flight robotic lander capable of carrying both scientific and exploration payloads to other planets or airless bodies.

The Center Management Council is used for Center governance and provides a center-level forum to evaluate technical performance of program and project work. The council is chaired by the center director and meets monthly, although special meetings can be called if necessary.

The CMC views the robotic lander taking flight and then performing a controlled landing.

The council is responsible for reviewing program and project performance to ensure adequate technical and institutional resources are being used to satisfy requirements and schedules. The council also reviews program and project risks and issues, and takes action to ensure Marshall is successful in meeting center commitments.

'Focus on Marshall' features final external tank rollout

By Lori Meggs

Gumbo, Mardi Gras parades and external tanks. All three share a common bond – they are all New Orleans staples. But for one, it's the final send-off, highlighted on the August episode of "Focus on Marshall" – the Marshall Space Flight Center's video program.

The "Focus on Marshall" team traveled to the Michoud Assembly Facility in New Orleans for the festivities surrounding the rollout of the final external tank for NASA's last space shuttle flight.

Viewers will see the tank up close and hear from managers and Michoud employees about the work that has gone into manufacturing them for 37 years.

"Focus on Marshall" airs on Marshall TV Aug. 12, 24 and 26 at 11 a.m., noon and 1 p.m. The series is available on NASA TV, Inside Marshall and on the NASA Portal.

Meggs, an AI Signal Research Inc. employee, supports the Office of Strategic Analysis & Communications.

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